THE ATMOSPHERE.

Air is Visible.—The blue color of the atmosphere on a fine day is well known. In proportion as we rise above the earth, the air becomes less dense, and the beautiful blue tint of the heavens disappears. Hence, travellers who have ascended to great heights, on the tops of mountains, tell us that the sky appears from those lofty elevations, of a greyish or blackish hue. This proves that the blue color does not belong to those portions of space in which the stars and other celestial bodies are placed, but solely and exclusively to the mass of air through which those bodies are seen. The same atmosphere, seen between us and the distant hills, causes the latter to appear blue.

It may, however, be objected, that if air be possessed of this peculiar kind of color, how is it that the air which immediately surrounds us is colorless? This objection is easily answered. There are certain colored bodies which reflect colored light so faintly, that it leaves no impression of color upon our senses. A glass of sea water, for example, if held up to the light, is perfectly limpid and colorless, but when we look at the ocean itself, the water appears green, it being there sufficient in quantity to render its color visible. In like manner, the air which fills an apartment, or which immediately surrounds us, when abroad, is not sufficient in quantity to be perceived; but when we view the immense mass of air in the firmament, when we fathom with our eye the depths of the aerial ocean above us, the blue color of the atmosphere is then distinctly visible. In proportion as the atmosphere is clear and free from vapors, this blue color becomes more intense, whilst it fades into a greyish or whitish hue, as the atmosphere becomes charged with them.

Air Possesses Inertia.—Inertia is that resistance offered by matter to any change in its condition as to rest or motion. A body at rest,

would continue forever at rest; in motion, forever in motion, if altogether uninfluenced by external causes. That a body at rest, a stone or a chair, for instance, cannot put itself into motion, independently of an external cause, is evident, forasmuch as it is borne out by fact and observation. We see that stones, chairs, tables, and other pieces of matter retain their places, and never move from them, unless some external force be applied; nor does any one imagine that they ever will. But, that matter in motion has a tendency to continne forever in motion, is not so evident; people think that it has a natural tendency to come to a state of rest, because they see that a stone or ball, if put into ever so violent motion, soon comes to a stand-still. But, if a little thought be given to the subject, it will be evident that all cessation of motion is to be attributed to the influence of some external cause; and that motion continues in proportion as those external influences cease. A ball, for example, if rolled on the ground, soon stops, owing to the friction of the uneven surface over which it moves; if it be rolled on ice, it continues longer in motion, and rolls much further, the smooth surface of the ice offering less resistance; but then, there is the resistance of the air, and the attraction of the earth; if these could be removed the body would roll forever. Now, that air, in common with solid and fluid matter, possesses this property of inertia, a number of familiar facts abundantly prove.

The resistance which air, in a state of rest, offers to a moving body, is a striking proof of its inertia. When the atmosphere is calm and free from winds, the particles of air maintain their position, and are in a state of rest. If a solid body, presenting a surface, be moved through the air whilst in this condition, a sensible resistance is encountered, arising from the particles of air attempting to maintain their position. The resistance of air, occasioned by its inertia, is felt in running, or when the hand is waved through it, backwards and forwards. The flame of a candle moved rapidly detects it.

Birds are enabled to fly by means of this resistance. In opening their wings, they cut the air by presenting their edge; but in closing they strike the air with their flat surface, like the motion of an oar in water. Birds do not fly above half a mile in height, and seldom more than one hundred yards. At considerable elevations, the atmosphere is too rarified to support them. Hence, those birds which rise to a great height in the atmosphere have large wings; as, for instance, the eagle, by means of which they are enabled to support themselves in the comparatively thin medium in which they move. Were it possible for a bird to live without respiration, in a place void of air, it would no longer possess the power of flight. Birds let go from balloons, at vast elevations in the atmosphere, fall rapidly into the denser strata of air below their surface, where they again recover their power of flight, the air not being sufficiently dense in those elevated regions to offer the necessary leverage or resistance for their wings.

On the deck of a steamer, a breeze is felt blowing from stem to stern, even in the calmest day, when not a zephyr lifts a leaf on shore, which is occasioned by the vessel displacing the air as it passes through it, exactly in the same manner as it displaces the water, and causing, as a consequence, a current of air to flow over the deck. A similar breeze, arising from atmospheric resistance, is felt on the outside of a steam-carriage, and, though formerly accounted a slight obstacle, is now found to be one of the most formidable hindrances to the velocity of the train; for as the resistance of the air increases directly as the ratio of the velocity of the train increases, its power becomes immense.

A cannon ball will travel twenty or thirty miles in vacuo, or in a space without air; but the resistance of the air limits its range to two or three miles.

THE RESISTANCE WHICH AIR IN A STATE OF MOTION OFFERS TO A BODY AT REST, IS ANOTHER MANIFESTATION OF ITS INERTIA.—We have seen that a body at rest would continue forever at rest; in motion, forever in motion, if altogether uninfluenced by external causes. This tendency of bodies to continue in the same state of motion or rest, is termed their inertia. Every example of the power of the wind (for wind is nothing but air in motion) is an example of the inertia of the atmosphere, and the strength of the wind like that of every other moving body, depends entirely upon the quantity of air in motion, and the velocity with which it moves.

When the wind blows one mile an hour, it is hardly perceptible: four, a gentle gale; 20 to 25, very brisk; 30 to 35, a very high wind; 50 to 60, a storm; 80 to 100, a hurricane uprooting the forests and sweeping the earth. The instrument used for measuring the force and velocity of the wind is termed an Anemometer. When the wind is gentle on the surface of the earth, it may be moving at the rate of from 60 to 80 miles an hour, in the higher regions of the atmosphere. This has been determined by the distance travelled by æronauts, and by observing the shadows of clouds moving along the ground. The æronaut travelling at the most enormous rate never feels the wind as he moves with it.

AIR IS POSSESSED OF GRAVITY OR WEIGHT.—The weight, or downward pressure of the air, is occasioned by the attraction of the earth, producing what is called atmospheric pressure. This pressure is exerted equally in all directions, the upward pressure of the air being equal to its downward pressure. By the following simple experiments, our readers may convince themselves of the upward pressure of the air.

Experiment 1. Fill a wine-glass with water place a slip of paper on the brim, so as to cover it entirely, and placing the palm of the hand on the paper, invert the glass; on removing the hand, the upward pressure of the atmosphere will cause the paper to adhere to the glass.

Exp't. 2. Close one end of a glass tube, two feet in length and one-sixth of an inch bore, with a cork, fill it with water, and placing one finger on the open end, invert it; on removing the finger, the upward pressure of the atmosphere will keep the water in the tube.

The peculiar gurgling sound which is produced in decanting bottles, is occasioned by the upward pressure of the atmosphere, which forces the air through the water into the bottles, to fill up the

vacuum created by the escape of the water. So long as the neck of the bottle is choked up with fluid, the water, in coming out, is intercepted by the entrance of the air, and flows with a gurgling and interrupted sound; but if the bottle be so inverted, that the liquid, in flowing out, only partially fills the neck, the flow of the water will be continuous and uninterrupted and no sound takes place.

It is in like manner owing to the upward pressure of the air that it supports clouds and other vapors which are seen floating in it. This phenomena proves the upward pressure of the air, in the same manner as a piece of floating wood or cork indicates the upward pressure of the water which supports it. On the same property depends the slow fall of light bodies, as paper, feathers, and snow, through the atmosphere, the upward pressure of the air impeding their descent. The upward pressure of the atmosphere in fact controls and modifies the effect of all falling bodies. Were it possible for the clouds to be supported, and the atmosphere to be removed, drops of rain falling from them would descend with the velocity and weight of shot to the earth's surface. This curious fact is finely exemplified by the philosophical instrument called the water-hammer.

The water-hammer is a glass tube, hermetically sealed, containing at one end a vacuum or space, without air, and at the other water. Upon inverting the tube, the water falls through the vacuum to the other end of it, as if it were lead, producing a short clicking sound. This noise is occasioned through the want of air to break the velocity of its fall. *The downward pressure of the air* may be detected in the following manner:

Exp't. 3. Procure a tin vessel shaped like a common phial, with the bottom full of very small holes; plunge it in water, with its mouth open, and when full, cork it so as entirely to exclude the access of the external air, then remove the vessel from the water. So long as it is kept corked, the upward pressure of the atmosphere will keep in the water; but when the cork is withdrawn, the downward pressure will cause it to stream through the holes at the bottom of the vessel.

Exp't. 4. Boil a small quantity of water in a retort, place a cork in the beak, and condense the steam by plunging the retort in cold water; now put the retort in an upright position, its beak being still below the surface of the water; remove the cork, and the downward pressure of the air on the surface of the water in the vessel, will force it with considerable violence into the retort, which will become immediately nearly filled with water.

This experiment is a very striking manifestation of atmospheric pressure.

It may, however, be objected, that we are not sensible of any weight in the air, which is, in fact, proverbial for its lightness; but science teaches us to rectify the deceptions of the senses. There is no difficulty in disposing of the objection, and this, too, in a very satisfactory manner. The answer is, that the effects of the pressure of the air around us are counteracted by the air that is within us; so that things are in a state of equilibrio. The surface of the body is covered with innumerable pores through which the insensible perspiration passes, which pores communicate with the atmosphere. Free and speedy access is thus given to the air to every part of the body; and hence the body is no more damaged by this pressure than a wet sponge is deranged by being plunged in water.

If, however, by any contrivance, we can cut off the communication between any part of the body and the surrounding atmosphere, then the elastic force of the air in the body will cause it to swell out into the vacuum, as in the operation of cupping, and we shall become powerfully, and even painfully, sensible of the pressure of the atmosphere.

Exp't. 5. Rarify the air in a wine-glass, by means of a piece of lighted paper conveyed into its inside, and instantly apply it to the palm of the hand, so as to exclude the surrounding atmosphere. The air in the wine-glass will cool and contract in volume, and the pressure of the external air will fasten the glass to the hand, the air in the hand at the same time expanding and causing the soft part of the palm to swell out into the vacuum.

The necessity of some inward æriform fluid, to sustain the outward pressure of the air, is well seen in the collapsing of cylinders and boilers, when, by some accident, the steam in them becomes condensed and a vacuum is formed. A simple experiment will illustrate this.

Exp't. 6. Boil a little water in a tin vessel provided with a stop-cock; when steam issues from the vessel, turn the stop-cock, so as to confine the steam, and pour a quantity of cold water on the sides of the vessel; a vacuum will be formed in the vessel, and its sides will be immediately crushed in by the powerful pressure of the external air.

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